Modeling Environmental Suitability for Establishment of *Burkholderia pseudomallei* in Texas

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Melioidosis Risk in Texas

Melioidosis is a neglected tropical disease that is characterized by pneumonia, abscesses, septicemia, and a high mortality rate of up to 40% or more. The disease is caused by an infection of *Burkholderia pseudomallei*, a soil dwelling, saprophytic, gram negative bacterium that is most often found in the warm soils of tropical regions. Infection is most commonly acquired through exposure of open wounds to soil or water containing *B. pseudomallei* or through inhalation of contaminated particles.

Exposure to contaminated water or soil, such as might occur while working in agriculture or walking through flood waters, is the primary source of infection

https://www.bangkokpost.com/thailand/general/823108/alert-sounded-over-deadly-melioidosis

While melioidosis is not common in the United States, several cases have appeared in Texas in recent years which indicate that the *B. pseudomallei* is or at least has been present in the state. The most recent documented case in Texas was notable for originating from exposure to contaminated aroma therapy spray sold in select Walmart stores across the US [1]. While the bacteria has not yet been directly found in soil in the United States, it's known introduction through contaminated products poses the question – can *B. pseudomallei* survive in Texas soils and thus present a risk to those who might come into contact with it? Previous research on predicting the global distribution of *B. pseudomallei* [2] indicated that environmental conditions could be used to study environmental suitability for the organism and that a similar approach could be applied to examine potential for the bacterium to become established in the continental United States in areas where it may have been introduced.

Aims & Methodology

- Generate geospatial data and maps to quantify habitat suitability for *B. pseudomallei* based on observed tolerance to environmental conditions associated with presence of the organism
- Lay a foundation for eventually combining outputs from our environmental suitability models with data related to flooding, land use, disease reporting, social vulnerability, and health risks so that a comprehensive melioidosis risk map can be developed

Data Inputs

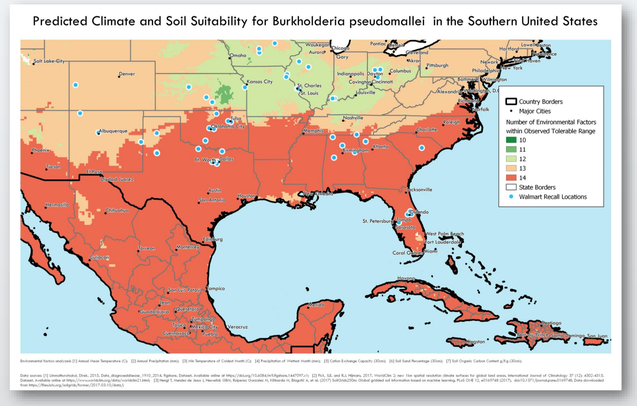
Data was collected that could be used to model where *B. pseudomallei* might be able to survive on Earth based on the environmental conditions where it has been found to exist in soil and water. All datasets utilized in the model had global coverage for all continents excluding Antarctica.

Documented occurrences of *B. pseudomallei* were obtained from Limmathurotsakul (2015) [3] . High resolution raster data for global soil conditions was obtained from SoilGrids [4] while similarly high resolution raster data for recent historical climate averages (1970 – 2000) was obtained from WorldClim[5].

Geospatial Analysis

A Python script was developed to automate the modeling process. This script leverages the QGIS Python libraries to process the input datasets and determine the range of environmental conditions that *B. pseudomallei* has been found to tolerate based on the characteristics of areas with positive water or soil samples. It then generates a resulting raster dataset in which each pixel indicates the number of environmental conditions in that area which are predicted to be suitable for survival of the organism.

Results



This predicted potential range of *Burkholderia pseudomallei* was based on documented worldwide positive soil and water samples from 1900 to 2013 and specific environmental conditions that have been found to be correlated with presence or absence of the organism in soil. This particular result indicates *B. pseudomallei* may be able to survive in areas where it was introduced into the US through sales of contaminated products. However, literature on environmental factors that are significantly correlated with presence of the organism are in some cases contradictory and altering the environmental factors considered in the model will lead to different results. As understanding of the environmental factors associated with presence of *B. pseudomallei* continues to improve, the model can be further tuned based on the factors that are found to have the greatest impact.

Acknowledgements

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